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The latter is fainter than *Saturn*, allowing for distance from sun and areas of illuminated surface.

"I have been looking into the relation between the period of sun-spots and the position of the principal planets as, in case of extensive chemical action going on in their atmospheres a reflex action on the sun, a sympathy between them, might be anticipated. At first all was promising up to 1826, as *Jupiter's* perihelia and aphelia answer tolerably to maxima and minima of spots, but previous to 1826 there is too much divergence. * * * *

"At all events, *Jupiter* should be studied henceforth with special reference to the relation between the physical constitution of its atmosphere and that of the sun."

GRANT TO THE LICK OBSERVATORY FROM THE SMITHSONIAN INSTITUTION.

The Smithsonian Institution, through its Director, Professor LANGLEY, has granted to the Lick Observatory a sum of money sufficient to provide a portion of the apparatus to be used in making enlargements of the Moon with the photographic object-glass of 33-inches aperture.

Experiments in this direction are already in progress. E. S. H.

HARVARD COLLEGE OBSERVATORY EXPEDITION TO THE SOUTHERN HEMISPHERE.

The following paragraphs from the New York *Herald* give one of the best accounts of this expedition which has so far appeared in print:

"The Harvard Observatory's expedition to Peru is on the eve of setting out—probably the best equipped, as it is to be the most comprehensive, scientific expedition ever sent forth.

"In prosecuting its self-assumed task of making a complete map of the heavens, the observatory has found it necessary to establish branch stations in order that the entire sky may be mapped, and, for this purpose, an astronomical plant has for some time been in operation on Wilson's Peak in Southern California. In May, 1889, a similar station was erected at Chosica, Peru, and there S. I. BAILEY and M. H. BAILEY, two of Professor PICKERING's lieutenants, have been at work systematically observing the southern hemisphere of stars. The observers at Cambridge have done all that they can do in this line—that is, they have located and described all the stars which

they can see. The observers at Wilson's Peak have collaborated to the best of their ability, and so have those at Chosica.

"In the latter case, however, climatic conditions have interfered to a very considerable extent, and it has been found necessary to remove the observatory to a point where the cloudy season is at a minimum. Mr. BAILEY made a temporary location in the desert of Atacama, one of the driest spots of the earth and nearer the coast than Chosica, and it has been concluded to establish a permanent observatory at a point near the city of Arequipa, where an eligible position has been secured at an altitude of about 8000 feet. To this point Professor W. H. PICKERING, accompanied by his family and by Messrs. A. E. DOUGLAS and R. W. VICKARS as assistants, is about to start. The BAILEY brothers will return to Cambridge after the new observatory shall have been established, but the party, which now goes, does not expect to see North America again in six or eight years. By the end of that time Professor PICKERING expects to have mapped the entire southern half of the heavens, which, as is well known, is far richer in bright stars, clusters and nebulae than the half with which we are familiar. He also will have hitherto unequaled opportunities for observing comets.

"Professor PICKERING also expects to be able to secure photographs of the moon which will be superior to any yet made, and he promises to show me at a date not very far distant a picture of her lunar majesty six feet in diameter. One of the results of the expedition, which will be of the greatest interest, will be the observations of *Mars*, which will be made when the mysterious little planet approaches the earth in August, 1892. *Mars* will then be nearer the earth than since 1872, and far to the south, and this fact, together with Professor PICKERING's altitude and the superb instruments at his command, leads to the expectation that we may be on the eve of remarkable discoveries regarding our very interesting planetary neighbor.

"The location selected is the easiest in the world to reach, for a line of railway leads to it from the coast, and thus the delicate and heavy instruments can be transported with ease and safety to the desired altitude. There are now in Peru, belonging to Harvard University, an 8-inch photographic doublet, a 5-inch visual telescope and an instrument for measuring the brightness of stars. Professor PICKERING is to take with him his unequaled "battery," a 13-inch photographic telescope, with an 8-inch "finder"; a 20-inch reflector, made in England, for photographing faint nebulae; a 2½-inch camera, mounted equatorially, the instrument which discovered the great spiral in

Orion; a portable transit for determining time, and a seismometer for observing earthquakes. Next year a 12-inch visual telescope will be added to this phenomenal equipment, so that there can be no failure on the ground of lack of instruments.

"There is no wood in the country where the expedition is going, and therefore, a great many things not at all astronomical—a dwelling-house, for example—have to be taken along. The steamer which takes the party will have in her hold even the domes and the iron piers for the telescopes.

"The observatory at Wilson's Peak has been temporarily abandoned."

SPECTROSCOPIC INVESTIGATIONS AT THE JOHNS HOPKINS UNIVERSITY [BY PROFESSOR H. A. ROWLAND].

"The visible and ultra violet solar spectrum has been compared with the spectra of different metals and the position of the metallic lines marked on the spectrum map with the view to identifying as many as possible of the more important lines of the solar spectrum. In this way the spectra of all known metals, with one or two exceptions, have been photographed and compared with that of the sun and its presence or absence in the sun determined. Silicon has thus been found in the sun for the first time. Many important solar lines have also been found to be due to vanadium and scandium. The presence of silver has also been definitely determined. Photographic studies have also been made of the spectra of various chemical preparations of minerals containing rare earths, with the view of isolating the spectra of the various components. This research is yet very incomplete.

"The homologous lines in the spectra of zinc and cadmium have been carefully compared. The so-called 'second spectrum of hydrogen' has been photographed in connection with the sun, and the wave lengths determined, and the spectrum of nitrogen has been photographed and studied in the same way. The various formulæ for the arrangement of lines in band spectra have been tested by means of more accurately determined wave lengths. Investigations have also been made of the effect of heat in modifying the magnetism of iron bars, of the cause of the enormous apparent values of the specific inductive capacity of amyl alcohol and certain other imperfectly insulating liquids. A large number of diffraction gratings have been ruled on the dividing engines for the use of investigators throughout the world. A series of photographic spectra of the metals from wave